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CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

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HEALTH HAZARD EVALUATION DETERMINATION REPORT

HHE-81-028 - 1059

CONSOLIDATED RAILROAD CORPORATION
READING, PA

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I. SUMMARY

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) at the Reading Car Shops, owned and operated by Consolidated Rail Corporation Incorporated, in Reading, Pennsylvania, between October and November 1980. The purpose of the investigation was to evaluate deteriorated insulation and ceiling material at the facility and to review three cases of malignant pleural mesothelioma in retired workers. The evaluation consisted of two site visits, bulk sampling and analysis of the materials in question and examination of the reported cases of mesothelioma.

Walk-throughs of the shops revealed an obsolete forced hot-water heating system which emanated from three boilers in a centrally located powerhouse. Hot water was distributed from this site throughout the facility in insulated heating mains. The insulation in this system was severely eroded. Analysis of bulk samples by phase contrast microscopy, and transmission electron microscopy (TEM) with microchemical analysis demonstrated asbestos in the powerhouse boilers, headers and benders, and in the heating mains of the freight car shop, passenger car and wheel shops. TEM analysis of ceiling samples from the freight car shop revealed hydrated calcium sulphate (gypsum). Review of clinical records, chest radiographs and tissue specimens confirmed all three cases of malignant pleural mesothelioma. Occupational histories confirmed asbestos exposure at the Reading facility from employment in the shops during the period of steam locomotive operations in the 1940's.

Based on the results of this investigation, NIOSH recommends that the insulation of the forced hot-water heating system be removed from all inhabited areas of the facility in accordance with removal, disposal and worker protection requirements of the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) (1,2). Unoccupied sites with deteriorated asbestos insulation, e.g. powerhouse boiler room, blacksmith shop and locomotive shop fan houses, should either have the material removed or the area sealed, labeled and access restricted as per the OSHA and EPA regulations. Recommendations for assessment of asbestos-related diseases in workers exposed from operations requiring asbestos before 1953 are listed on page 5.

II. INTRODUCTION

Under the authority of the Occupational Safety and Health Act of 1970 (29 U.S.C 669(a)(6)), the National Institute for Occupational Safety and Health evaluates the potential hazard of substances found in the workplace.

In October, 1980, NIOSH received a request for a health hazard evaluation at Con Rail Corporation's Reading Car Shops, Reading, Pennsylvania. The request, submitted by the International Association of Machinists, specified two problems: exposure to current workers from decaying material in ceiling and pipe insulation, and asbestos exposure to employees during steam locomotive activities prior to 1953.

The investigation was requested to evaluate the composition of the freight car shop's ceiling as well as the composition and condition of insulation from an obsolete heating system. NIOSH was also asked to evaluate the health impact of asbestos exposure to workers during the steam era given the occurrence of mesothelioma in several retired workers.

III. BACKGROUND

Until 1979 all buildings at the Reading facility were heated by a forced hot water system that originated in a powerhouse. Boilers located therein generated steam and hot water which were distributed to all the buildings via insulated heating mains located twenty-five feet overhead. Although this system has been supplanted by stationary oil-fueled heaters, it remains in place throughout the shops. Labor's concern that the condition of the insulation posed a health hazard resulted in its partial removal from one work area, the passenger car and wheel shop. Analysis of this material by management's contractor, Empire Wrecking Company, revealed asbestos.

The recent diagnosis of malignant mesothelioma in three retired workers of the Reading Shops generated labor interest in asbestos exposure during the steam era, 1902-1953. In this period activities included the construction and maintenance of steam locomotives and railway cars. Asbestos exposure resulted from lagging of boilers and fireboxes with blocks containing 15% asbestos and 85% magnesium carbonates. Asbestos-containing hair, felt and cement products were also used in railway car insulation. While only 392 workers are now employed at the Reading facility, 4500 workers per year were employed during steam engine operations prior to 1953 (3).

IV. METHODS AND MATERIALS

Bulk samples of pipe insulation were collected in the freight car shop, passenger car and wheel shop and in the boiler room of the powerhouse. Bulk samples were gathered from the insulation of the boilers. A portion of insulation from a pipe on a railway diesel car and a bulk sample of ceiling material from the freight car shop were also obtained.

Phase contrast optical microscopy and polarized light microscopy were used to identify asbestos fibers. Transmission electron microscopy with microchemical analysis was utilized for confirmation of light microscopic findings in selected samples. (4)

Review of the reported cases of malignant mesothelioma was performed by consultation with the referring physician, examination of pertinent clinical data including histories, radiographs and tissue sections, and interview of patients or next of kin.

V. EVALUATION CRITERIA

The documentation of asbestos in an exposed, eroded and friable surface indicates the presence of a definite health hazard (1). Evaluation of human data provides no evidence for a threshold level of asbestos exposure below which there is no risk of disease. The asbestos standard recommended by NIOSH is 0.1 fibers/cc (100,000 fibers/m³) for fibers greater than five microns in length in an eight hour period. (9) This standard is based on the lowest level detectable by phase contrast microscopy, the only generally available and practical analytical technique at the present time.

Evaluation of the three mesothelioma cases was performed at the Division of Respiratory Disease Studies, NIOSH, utilizing pathologic consultation and criteria. (5)

VI. RESULTS

The heating main insulation at the facility was severely deteriorated. Chipping, flaking and dangling from pipes was evident in all areas. Powerhouse boiler insulation, however, was in good repair. Most of the 392 current workers are employed in shops containing segments of this obsolete heating system. The boiler area of the powerhouse was used by workers until September, 1980, and still maintains open communication with the inhabited transformer portion of the building.

All samples of insulation collected from pipes of the heating system and boilers contained asbestos, (Table I Appendix). No asbestos was detected in the pipe covering collected from a railway diesel car. The ceiling sample from the freight car shop was determined to be gypsum.

NIOSH review of tissue specimens, radiographs and historical data confirmed the three cases of malignant, pleural mesothelioma. All cases were male machinists with a median duration of asbestos exposure at the Reading Shops of 14 years prior to 1953. Mean tenure at this worksite was 36 years for the cases and histories failed to reveal other nonoccupational sources of potential asbestos exposure.

VII. DISCUSSION AND RECOMMENDATIONS

A. Asbestos Insulation

Corrective action must be taken to control asbestos exposure from pipe and boiler insulation. Removal or encapsulation are potential interventions, each suitable for specific sites. Only removal is a permanent solution, however, since this completely eliminates the source of exposure. EPA and OSHA regulations regarding asbestos stripping, disposal and worker protection are contained in references 1 and 2.

Encapsulation consists of coating the asbestos material with a bonding agent or sealant. Sealants penetrate and harden the surface of a material thereby preventing asbestos fiber release. Sealant application by spraying should occur at the lowest possible nozzle pressure since spraying causes the release of small fibers to the local environment. Encapsulation is restricted to areas where contact damage will not occur. It is also limited to asbestos that retains bonding integrity in order for the additional weight of the sealant to be supported. The treated area should be clearly posted for asbestos and a regular monitoring program should be created to assure that the protective system maintains its integrity over time.

Encapsulation or removal are appropriate methods for controlling asbestos exposure from the insulation of powerhouse boilers. This material is in good condition and in an area that is rarely entered or used. Encapsulation would not be an effective means of controlling asbestos exposure from the insulation of the heating lines. The deteriorated state of this material would not support the sealant. This material must be removed. The following recommendations are made:

1. Asbestos from heating mains should be removed from all inhabited areas including: freight car shop, passenger car and wheel shop; frog shop.
2. All access to the powerhouse boiler room should be eliminated unless NIOSH-approved respiratory protection is taken. This area should be completely sealed including doors, windows, skylights and ventilatory connections with the remainder of the building. Asbestos hazard warnings should be posted at all access sites. These temporary measures should precede removal of asbestos pipe insulation and removal or encapsulation of boiler insulation in this area.
3. Locomotive shop fan houses should be treated as in Item #2 above.
4. Access to the blacksmith shop should be eliminated, doors should be locked, and asbestos warnings posted on each.
5. Asbestos removal, disposal and worker protection practices must comply with all EPA and OSHA regulations, references 1 and 2 and summary in Table 2 appendix. These regulations should be posted at the work site.

B. Asbestos Exposure and Mesothelioma

Malignant mesothelioma is a rare tumor whose only known risk factor is asbestos exposure. This strong association has been clearly established in numerous epidemiologic and experimental investigations.(6)

Mesothelioma is, however, the least common result of asbestos exposure and its latency period* is the longest of any asbestos-associated disease, often exceeding 35 years. (7,8)

The mesotheliomas diagnosed in retired employees are consistent with their asbestos exposure at the Reading Shops prior to 1953. These malignancies also suggest the occurrence of more common, asbestos-related diseases in the population exposed during the steam era, e.g. asbestosis. The risk to this population of diseases from asbestos exposure is definite but remains to be quantified. This assessment is of considerable importance for several reasons. First, the magnitude of employment in American railroad shops prior to 1954, the steam era, approached one quarter of a million workers per year.(3) Second, health care providers have little knowledge of asbestos exposure and disease risk in this occupational group. Third, there is likely to exist a significant survivor population with increased non-malignant pulmonary morbidity and mortality secondary to this asbestos exposure.

Based on our findings, the following investigations are planned:

1. Survivors with work experience during the steam era will be identified and offered screening by NIOSH for asbestos-associated pulmonary diseases. Chest radiography, and the NIOSH occupational questionnaire can be utilized for this purpose.
2. An industrywide standardized mortality study of selected railroad shop workers with asbestos exposure before 1953 will be designed. This cohort can be defined and followed by data from the Federal Railroad Retirement Board, the Social Security Administration and State Health Departments.

*Latency period is the interval between first exposure and clinical occurrence of disease.

VIII. REFERENCES

1. Environmental Protection Agency, Regulation 40, Code of Federal Regulations 61, Subpart B: National Emission Standard for Asbestos.
2. U.S. Department of Labor, Occupational Safety and Health Administration, Asbestos Regulations, Code of Federal Regulations Title 29, Part 1910.1001: Occupational Exposure to Asbestos.
3. Interstate Commerce Commission, Statistics of U.S. Railways, Department of Transportation, 1900-1954.
4. National Institute for Occupational Safety and Health, Review and Evaluation of Analytical Methods for Environmental Studies of Fibrous Particulate Exposures, Public. No. 77-204, U.S. Dept. HEW, 1977.
5. Kannerstein M., Chung J., "Mesothelioma in Man and Experimental Animals", in *Envir. Health Perspectives*, Vol. 34, pp. 31-36, 1980.
6. Lemen R.A., Dement J.M., Wagoner J.K., "Epidemiology of Asbestos Related Disease", in *Envir. Health Perspectives* Vol. 34, pp. 1-11, 1980.
7. Becklake M.R., "Asbestos-Related Diseases of the Lungs and Other Organs: Their Epidemiology and Implications for Clinical Practice," in *Amer. Rev. Resp. Dis., State of the Art*, pp 55-95, 1975.
8. U.S. Department of Health and Human Services, NIOSH, Workplace Exposure to Asbestos, Public. #81-103, November, 1980.
9. Revised Recommended Asbestos Standard, National Institute for Occupational Safety and Health, Public No. 77-169, U.S. Dept. HEW, 1977.
10. U.S. Department of Health, Education and Welfare, A guide to Industrial Respiratory Protection, Public. No. (NIOSH) 79-107.

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APPENDIX

TABLE 1 Sampling Analysis

<u>Sample/Site</u>	<u>Polarized Light & Phase Contrast Microscopy</u>	<u>Transmission Electron Microscopy</u>
Pipe Insulation: Powerhouse Boiler Room	Asbestos	Asbestos
Pipe Insulation: Freight Car Shop	Asbestos	Asbestos
Pipe Insulation: Passenger Car (2 samples) Wheel Shop	Asbestos	-----
Pipe Insulation: Railway Diesel Car	No Fibers Detected	,
Insulation: Powerhouse Boilers	Asbestos	-----
Ceiling: Freight Car Shop	-----	Gypsum

Table 2 Asbestos Removal and Disposal:
Some EPA, OSHA Requirements^{1,2}

1. Approval must be obtained for a waste disposal site in compliance with EPA regulations.
2. Workers should be provided with NIOSH approved respirators for asbestos containing dusts. Each worker should be evaluated by a physician for ability to wear a respirator and instructed in the proper fitting, maintenance and cleaning of his respirator. (10)
3. A decontamination facility consisting of a clean change room, and shower area must be set up adjacent to the work area. All persons before entering the work area shall remove street clothes in the change room and put on disposable full body coveralls, headcovers and footwear. Workers should not eat, drink, smoke or chew gum in the work area. Disposable coveralls, headcovers and footwear are to be removed before leaving the work area. Workers will fully decontaminate by showering.
4. All equipment generally housed in the work area should be removed. All openings and fixtures including heating and ventilation ducts, skylights, doors and windows should be thoroughly sealed with 6 mil minimum polyethylene sheets.
5. The asbestos material should be sprayed with water containing a wetting agent. To enhance penetration the wetting agent should be 50% polyethylene ester and 50% polyoxyethylene ether at a concentration of 1 ounce per 5 gallons of water. A fine spray of this solution should be applied to prevent excessive fiber disturbance preceding the removal of the asbestos material. The removed material should be packed while still wet into labelled 6 mil plastic bags and placed into metal drums or skips for transport. The bags and drums should be labelled according to OSHA specifications and the outside of the drums should be cleaned before leaving the work area.
6. All plastic sheeting, tape, cleaning material, clothing and all other disposable material used in the work area should be packed into 6 mil plastic bags and placed in labelled drums. The sealed drums must be transported to the approved disposal site.
7. All surfaces in the work area must be cleaned with water and/or a High Efficiency Particulate Absolute (HEPA) filtered vacuum. (A HEPA vacuum will fail if used on wet material) After a 24 hour settling period, the entire area must be cleaned again.
8. Air monitoring is required as set forth in OSHA Standards 1910.1001. Air samples should be taken before, during and after asbestos removal.
9. Areas with encapsulated asbestos should be monitored routinely by visual inspection for as long as the material remains in place.